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Performance Analysis of Silica Sand as a Processing Material Introduction Microfiltration Membranes for Treating Hospital Wastewater

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Abstract: Alternative methods of treating hospital wastewater can use a microfiltration membrane, where the results of the study show that the removal of oily wastewater reaches 82.5%, BOD 90%, COD 85% and total Coli up to 70%. In addition, it can remove particles from wastewater measuring 0.04 to 100 microns. The problem faced in the use of microfiltration membranes is the rapid occurrence of fouling / saturation on the surface of the microfiltration membrane causing the wastewater treatment operation time to not be long. The lack of time for this treatment causes the problem of a small amount of wastewater being treated and other problems, membrane replacement is faster. The purpose of this study was to determine the performance of silica sand as a preliminary treatment for microfiltration membranes to reduce the content of parameters pH, BOD, COD, TSS, Ammonia, Fatty Oil and Total Coliform of wastewater. The results of the study are as follows: 1) The average quality of hospital wastewater is temperature 28.8 C, pH 7, BOD 79 mg/l, COD 167.05 mg/l, TSS 68 mg/l, Ammonia 4 mg/l, Phosphate 0.745 mg/l, Fatty Oil 1.64 mg/l, Coliform 2,200 MPN/100 ml. 2) The efficiency of reducing silica sand to parameters, namely for wastewater temperature 2.94%, pH 2.94%, BOD 78.24%, COD 56.25%, Total Solid Suspended (TSS) 75.85%, NH3 (Ammonia) 56.49%, Phosphate (PO4) 39.13%, Oils and Fats 34.38%, and Coliform 27.27% MPN/100 ml.

Keywords: Preliminary Treatment, Silica Sand, Hospital Waste Water

1. Preliminary

The hospital is one of the health care facilities that produces a large amount of waste water in its operational activities. Waste water comes from patient bathing, washing and latrine activities, laundry, kitchens, laboratories, places of worship and other sanitation activities.

Nowadays, in general, hospitals in Indonesia treat wastewater using a biological method, namely the anaerobic anaerobic biofilter system. This is based on the WWTP Technical Guidelines for Health Service Facilities which are the reference for hospital wastewater treatment.

This method of wastewater treatment with anaerobic aerobic biofilter system has a weakness because it requires an expensive investment, because it requires a large area of land, uses an expensive biofilter, pump, blower and chemicals in its operation. Currently the technology for water purification and wastewater treatment can use a microfiltration membrane, the microfiltration membrane used has a size of 0.05 m and is used for oily wastewater with a removal of up to 82.5% (Widyasmara et al., 2013).

Although previous studies of microfiltration membranes have proven the success of treating wastewater, the problem faced is the occurrence of fouling/saturation on the surface of the microfiltration membrane, causing the wastewater treatment operation time to not be long. The lack of time for this treatment causes problems with the amount of

wastewater produced being less and membrane replacement is faster.

This study aims to determine the results of the analysis of the performance of silica sand as a preliminary treatment material for microfiltration membranes to treat hospital wastewater.

The benefit of the results of this research is the research product, namely the hospital wastewater treatment method using a microfiltration membrane that can be applied to WWTP in health care facilities, especially hospitals and as a reference for development and reference in environmental health disciplines.

2. Research Methods

The research flow is described below

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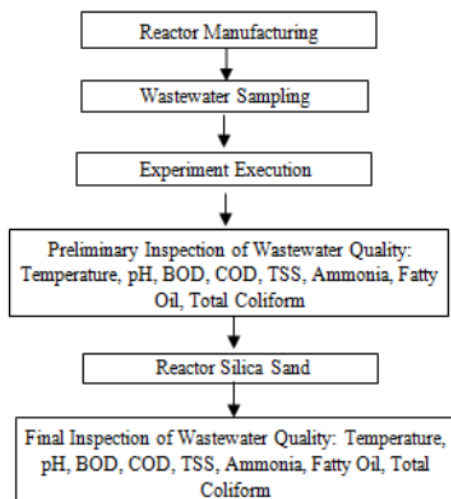


Figure 1.1: Research Flow

The research conducted is a quasi-experimental, namely research that aims to explain things that will happen to the research variables with a design using pre-test (before treatment) and post-test (after treatment) for the object under study.

In this study the independent variable is Silica Sand Material. While the dependent variable is the quality of wastewater with parameters pH, BOD, COD, TSS, Ammonia, Fatty Oil and Total Coliform.

The research conducted in 2021, at the Tanjungkarang Health Department Environmental Health Workshop and wastewater samples were obtained from the Wastewater Treatment Plant (IPAL) RSIA Puri Adhya Paramitha Bandar Jaya, Central Lampung.

The Research Reactor can be seen below.

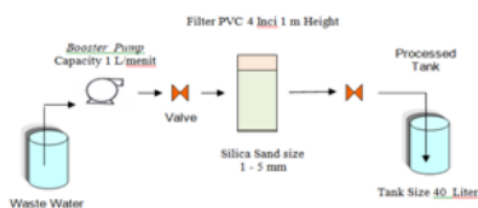
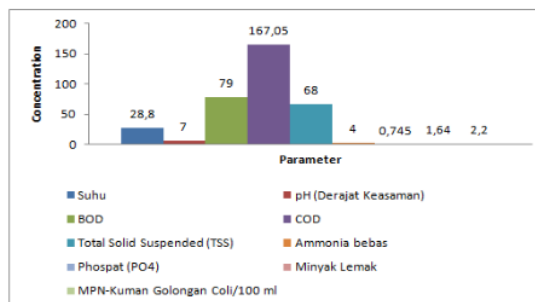


Figure 1.2: Research Reactor

3. Results and Discussion

The research focuses on the analysis of the performance of silica sand as a preliminary treatment material. This is due to the problem of fouling / saturation of the microfiltration membrane in treating hospital wastewater. Silica sand can function to purify wastewater so that the materials that cause fouling in the microfiltration membrane such as suspended solids, colloidal particles and organic matter can be removed so that the operating time of the microfiltration membrane can last a long time in treating hospital wastewater.

1) Hospital Preliminary Wastewater Quality

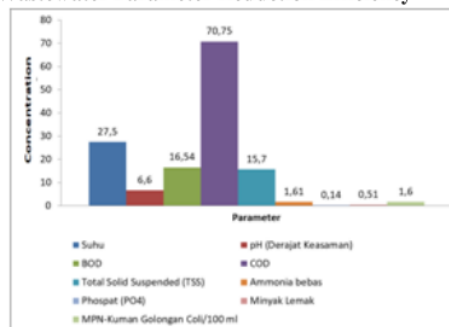


Graph 1.1: Average Initial Hospital Wastewater Quality

Based on the tables and graphs above, the quality of hospital wastewater shows the average quality of wastewater at a wastewater temperature of 28.8°C, pH (acidity) 7, BOD 79 mg/l, COD 167.05 mg/l, Total Solid Suspended (TSS) 68 mg/l, Free Ammonia 4, Phosphate (PO4) 0.745 mg/l, Oils and Fats 1.64 mg/l and Coliform 2.200 MPN/100 ml sample.

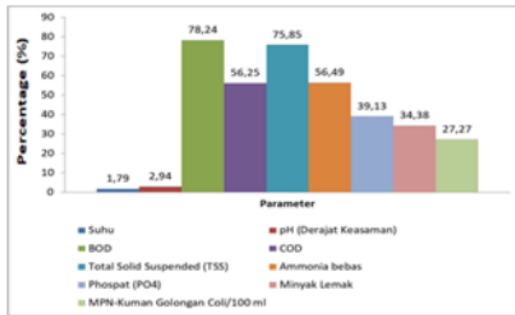
Based on the results of the research, samples of hospital wastewater were tested in the Regional Health Laboratory, Lampung Province, Indonesia by testing 9 parameters, namely temperature, pH (acidity degree), BOD, COD, Total Solis Suspended (TSS), free ammonia, Phosphate (PO4), fatty oils, and MPN-Co₃. The initial hospital wastewater samples were compared with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No.P, 68/ Menlhk/ Setjen/ Kum, 1/8/2016 concerning Domestic Wastewater Quality Standards with the results that there were several parameters that did not meet the requirements, namely, BOD, COD, and Total Solid Suspended (TSS) and free Ammonia (KEMENLHK, 2016)

2) Wastewater Parameter Reduction Efficiency



Graph 1.2: Average Decrease in Wastewater Parameters in Silica Sand

Based on graph above, the average results obtained after processing on silica sand, wastewater temperature 27.5 °C, pH (acidity degree) 6.6, BOD 16.54 mg/l, COD 70.75 mg/l, Total Solid Suspended (TSS) 15.7 mg/l, Free Ammonia 1.61 mg/l, Phosphate (PO4) 0.14 mg/l, Oils and Fats 0.51 mg/l and MPN-Germ Coli 1,600 Total/ 100 ml of sample.



Graph 1.3: Average Percentage Decrease in Wastewater Parameters on Silica Sand

In the average percentage reduction in silica sand, the results obtained are the wastewater temperature 1.79%, pH (acidity) 2.94%, BOD 78.24%, COD 56.25%, Total Solid Suspended (TSS) 75.85%, Free Ammonia 56.49%, Phosphate (PO4) 39.13%, Oils and Fats 34.38%, and MPN-Germ Golonga Coli 27.27%.

Based on research that has been carried out on wastewater that has been treated using silica sand media, and which has been checked at the Health Laboratory of Lampung Province, the results show that silica sand is able to improve the quality of hospital wastewater and reduce the content of wastewater parameters. can be explained by the statements below.

The up flow sand filter system is a liquid waste treatment system which basically is to drain liquid waste through a sand filter media, with the flow direction from below the sand media to the top of the sand media, so that the filtering results are above the raw waste. Filtration with an up flow system is seen as more effective to minimize the occurrence of deadlocks in the media due to the high turbidity of the raw waste. In addition, with a system like this, it will be easier to wash the media, which is enough to open the drain valve which will drain cleaner processed products, (Artiyani and Firmansyah 2016).

Silica sand is the result of weathering of rocks that contain major minerals such as quartz and feldspar. The use of silica sand is to remove the physical properties of water, such as turbidity/muddy water and to remove odors from the water. In general, silica sand is used in the early stages as a filter in processing dirty water into clean water (Artiyani and Firmansyah 2016).

The porosity of silica sand at size > 1 mm is 34.1%; The porosity of silica sand with size 1.0 > 0.5 mm is 37.97% and silica sand with size 0.5 mm is 41.51%. The higher the porosity of the silica sand, the higher the adsorption rate will be. The best silica sand used as a filter is silica sand with a size of 0.5 mm which is the most optimum silica sand as a water filter media in this study (Darmono, 2005).

Based on several previous studies where silica sand can be a medium to improve or reduce the quality of wastewater with various thicknesses. So that in this study, activated carbon media with a column height of 100 cm, and a pipe diameter of 4 inches (multiples of 4 from the previous study) used

with silica sand size 0.5 mm which is the most optimum silica sand as a water filter media in previous studies, and designed to avoid fouling in a short time.

4. Conclusions and Suggestions

From the results of the study, the following conclusions and suggestions were obtained:

- 1) Average concentration of hospital wastewater parameters temperature 28.8 oC, pH 7, BOD 79 mg/l, COD 167.05 mg/l, Total Solid Suspended (TSS) 68 mg/l, NH3 (Ammonia) 4, Phosphate (PO4) 0.745 mg/l, Oil and Fat 1.64 mg/l and Coliform 2.200 MPN/100 ml sample.
- 2) The average removal efficiency of silica sand material for parameters is 2.94%, BOD 78.24%, COD 56.25%, Total Solid Suspended (TSS) 75.85%, NH3 (Ammonia) 56.49%, Phosphate (PO4) 39.13%, Oils and Fats 34.38%, and Coliform 27.27% MPN/100 ml.
- 3) Carry out further research on the application of preliminary treatment on field-scale microfiltration membranes at research partner hospitals.
- 4) Using silica sand as a preliminary treatment material to prevent fouling/saturation during field-scale research using a microfiltration membrane.

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